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TITLE

GROWTH RATE OF SUGAR PINES IN RELATION TO ATTACKS BY THE MOUNTAIN PINE BEETLE

Preliminary Report

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GROWTH RATE OF SUGAR PINES IN RELATION TO ATTACKS BY THE MOUNTAIN PINE BEETLE

Preliminary Report

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INTRODUCTION

Growth rate may be a very important factor in determining the susceptibility of sugar pines to attacks by the mountain pine beetle. For some time this factor has entered into studies of the reasons why certain trees are attacked apparently in preference to others. Growth rate is recognized as only one among many factors which may be important. If there is a positive correlation between growth rate and susceptibility to beetle attacks, then this factor can be regarded as highly significant.

Studies on the relationship between growth rate in ponderosa pine and attacks by the western pine beetle1/ have resulted in positive and consistent correlations. Slow growing trees are preferred to those of faster growth, regardless of the intensity of infestation, with a greater sensitivity of choice shown during endemic conditions. These results indicate that it may be feasible to use growth rate as an index of the susceptibility of ponderosa pine to beetle attacks in west side (Sierra) stands. Similarly in sugar pine, if consistent correlations are found to exist between mountain pine beetle attacks and growth rate, the growth factor may then be used as an index of susceptibility.

Preliminary information on growth rate selection in sugar pine was indicated in 1924 by J. M. Miller from 25 living and 25 insect killed trees from virgin stands of timber near Ellis Meadow (Sierra National Forest), but the data were not officially recorded. The unofficial opinion was that there was no evident correlation between the two classes of trees.

Growth rate studies of sugar pine have thus far been limited to comparisons between single insect killed and living check trees. To date 83 insect killed trees have been compared with an equal number of checks on virgin and cut-over reserve areas located on the Sierra and Stanislaus National Forests. Although this number of records probably falls far short of enough to serve as an adequate basis for conclusions, we are interested to find out if any trends are indicated. These records were taken during 1932, 1937, and 1941 by the writer. In each instance check trees were selected with utmost care regarding similarity in characteristics, site, and growing conditions with the beetle killed trees. The discussion that follows is based entirely on these data.

1/ Struble, G. R. Cascadel Tree Selection Plot. A Study of Tree Selection by the Western Pine Beetle. Final Report. April 10, 1942.

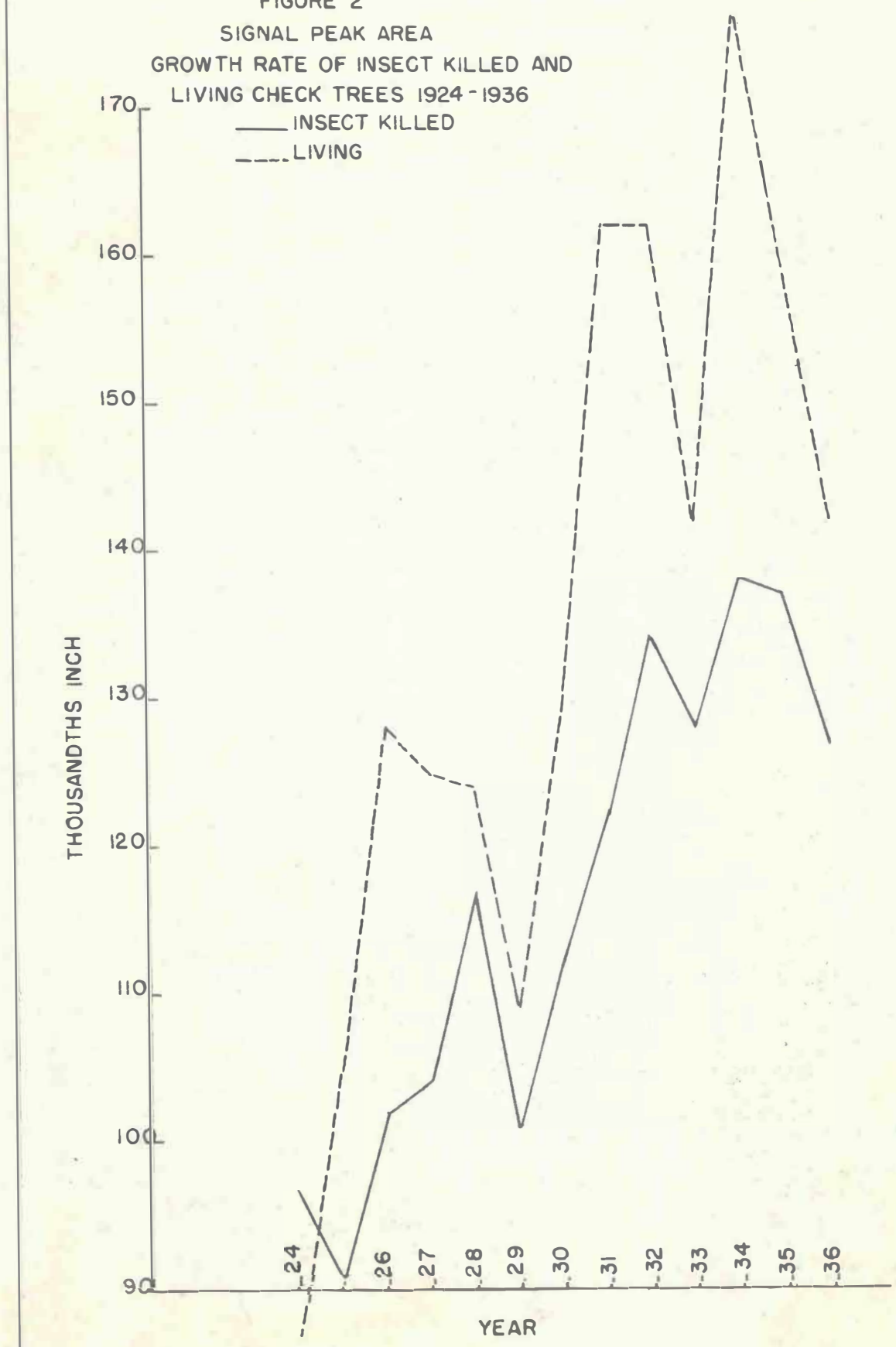
FIGURE 1.
GROWTH RATE OF INSECT KILLED AND LIVING CHECK TREES - WHISKEY CREEK AREA - 1932

FIGURE 2

SIGNAL PEAK AREA

GROWTH RATE OF INSECT KILLED AND

LIVING CHECK TREES 1924 - 1936



WHISKEY CREEK DATA - 1932

The area of infestation included here borders on each side of the road approaching Whiskey Creek and extends beyond as far as Ellis Meadow (Sierra National Forest). Parts of the area had been logged within 1 to 3 years previous to this study. Most of the increment cores used were taken in virgin type stands (Site II quality) in the vicinity of Whiskey Creek. The mountain pine beetle was particularly active here in 1932.

Twenty-five trees killed by the mountain pine beetle and 25 green check trees were considered in this comparison. Figure 1 presents the comparative average growth rates of each group. The interesting feature of this curve is that up to 1938 the average growth rate of the insect killed trees remained higher than that of the living checks, and lower after 1938 with a wider spread between the two groups than before that date. This may indicate that a sudden and more rapid lowering in rate of growth, caused possibly by some unknown factor, may have been sufficient to render these trees susceptible to beetle attack. On the other hand, the relatively small number of trees in the comparison may be responsible for this deviation. The actual difference in growth rate of approximately .09 inch, however, is probably insufficient to make a great deal of difference in susceptibility.

SIGNAL PEAK DATA - 1937

The area from which increment cores were taken at Signal Peak on the Sierra National Forest was logged about 1928, according to Forest Service specifications. The reserve stand of sugar pine (Site II) is composed of thrifty appearing trees with diameters varying from 18 to 54 inches. The mountain pine beetle became active locally between 1935 and 1938 as a result of blow downs in 1934 and 1936 which provided the beetle with an abundance of breeding material from which infestations spread to surrounding living trees.

The cores used in this growth selection study were taken from 13 insect killed and 13 green check trees. The average growth rate of each group from 1924 to 1936 is plotted in Figure 2. This graph shows an appreciable difference in growth rate between the insect kills and living checks. The living check trees grew more rapidly throughout the period (1924-1936) except 1924, with greater differences shown in the last few years prior to 1936. The selection for slower growing trees here is indicated, but the full significance of it is obscured by the fact that all trees considered were growing rapidly on this cut-over area. Possibly on cut-over areas the selection for slower growing trees may occur to this extent. Here again 13 trees is not a very strong basis for a just comparison.

PINE CREST DATA - 1941

Cut-over reserve stands near Pine Crest (Stanislaus National Forest) were affected by aggressive mountain pine beetle activity during the summer

FIGURE 3

PINE CREST AREA

GROWTH RATE OF INSECT KILLED AND LIVING

CHECK TREES 1921-1940

FIGURE 4

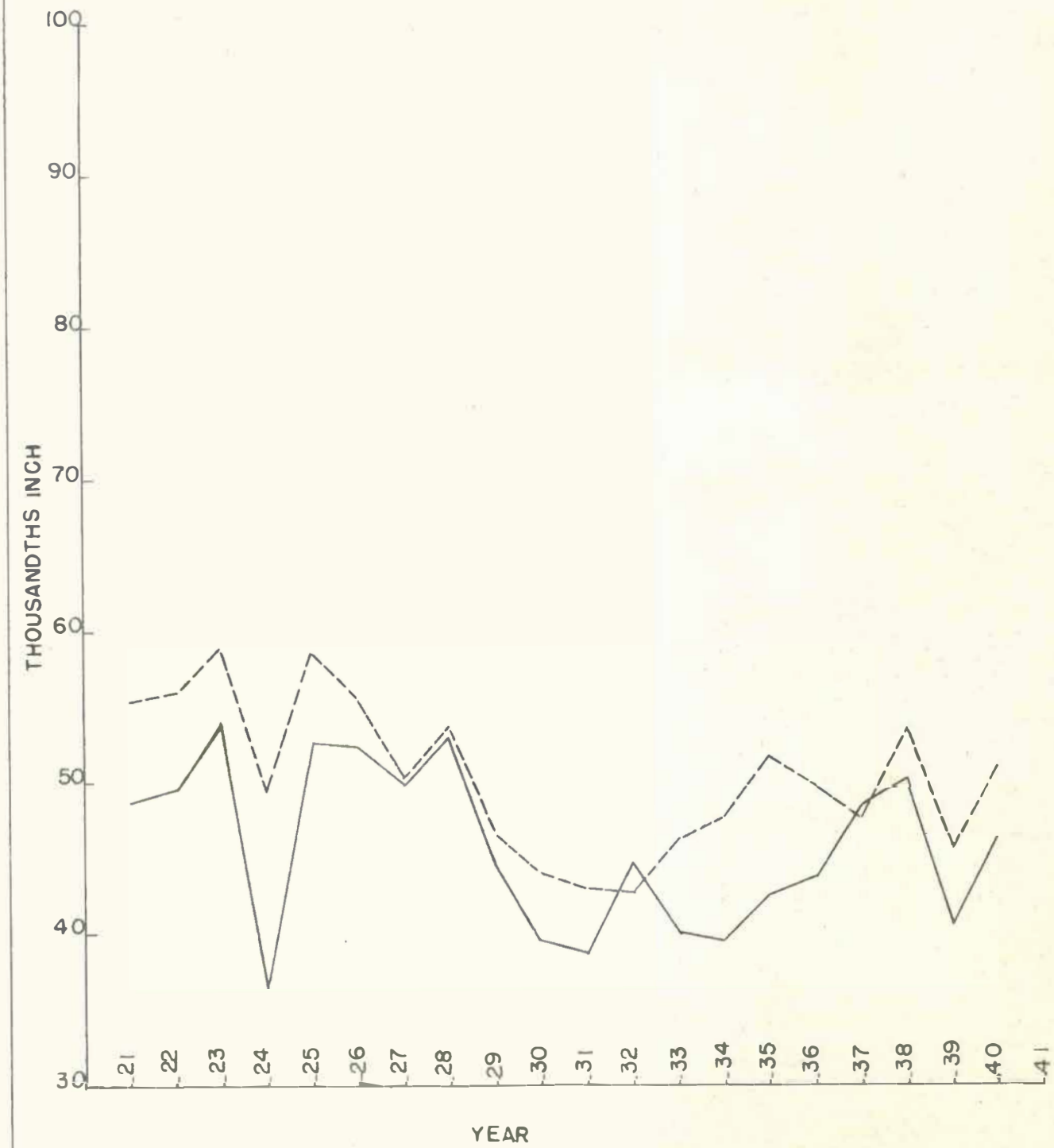
SHAVER LAKE AREA

AVERAGE GROWTH RATE OF INSECT KILLED

AND LIVING CHECK TREES 1921-1941

———— INSECT KILLED

– – – – LIVING



and fall, 1941. This area was logged in 1929 according to Forest Service specifications, and a good stand of thrifty trees was left. Most of the area is Site II quality. Beetle killed trees were found scattered through the area during the early fall, with concentrations directly east of the Tuolumne River (north fork).

Increment cores were taken from 20 dead trees and 20 living check trees. The comparative average growth rate of each group is shown by Figure 3. As on the Signal Peak cut-over stand, the check trees on this area were growing consistently faster than the insect killed trees. The interesting feature of this graph is that after 1933 there was an increasing tendency toward a broader spread in growth rate between the two groups. Here, as on the Signal Peak area, growth rate is indicated as a susceptibility factor. Its significance may be apparent only because of changed growing conditions on cut-over areas.

SHAVER LAKE DATA - 1942

The Shaver Lake area includes both virgin type and cut-over timber. Sugar pine is the most important species and large bodies of mature trees occur in the vicinity of Stevenson Creek and Music Mountain. The mountain pine beetle became aggressive in this area during 1940 and continued active during 1941, killing many trees. Greatest activity occurred in the virgin stands.

Increment cores were taken in March 1942, during a Forest Service insect control project. Twenty-five cores each were taken from insect killed and living check trees on virgin areas in the vicinity of Stevenson Creek and Music Mountain. Measurements of annual rings included the period from 1921 to 1941. The average growth rate of each group is plotted in Figure 4. The difference in rate of growth between the dead trees and living check trees here is probably not sufficiently great to be a factor in selection. Except during two years of the entire period covered by this comparison (1921-1941), the average growth rate of the check trees remained only slightly above the insect kills. On the basis of individual comparisons 14 of the insect killed trees were growing slower than the checks. This fact also indicates that the growth rate of trees on this area was not a selection factor. Possibly one of the reasons for this is that the growth rates of all of the trees studied were sufficiently low to render them susceptible to attack, and hence there would be no great evidence of growth rate selection.

DISCUSSION

In comparing the growth rate of insect killed and living trees on the 4 areas a few interesting points are noted: (1) That on the virgin areas (Whiskey Creek and Shaver Lake) the difference was not great and consequently the possibility of growth rate being a factor in selection is minimized; (2) that on cut-over areas (Signal Peak and Pine Crest) the differences in rate of growth between insect killed and living check trees may be sufficiently broad as to indicate that growth rate may be a factor in selection; (3) that the growth rate of both living and insect killed trees on the cut-over areas was considerably higher than the growth rates of the trees compared on the virgin areas.

The average growth rate of individual trees compared with checks during the period considered shows that an appreciable number of the insect kills were growing faster than the checks as indicated in the following table.

Table 1. Trees Killed by the Mountain Pine Beetle Growing Faster than Checks

Area	Period	Growing faster than checks	Percent of total growing faster
Whiskey Creek	1919-1931	14	56
Shaver Lake	1921-1940	11	44
Signal Peak	1924-1936	6	43
Pine Crest	1921-1940	6	30
Total		37	45

This table shows that on all except the Whiskey Creek area the choice for slow growing in preference to fast growing trees was little more than a matter of chance. On the Whiskey Creek area there was a slight preference for faster growing trees and on the Pine Crest area there seemed to be a fairly strong selection of slower growing trees. The total for all areas studied shows that 37 dead trees or 45 percent of the total were growing faster than the checks.

Because of the small number of trees compared it is hazardous to draw any conclusions on the relation between growth rate and selection at the present time. Probably no less than 500 dead and an equal number of check trees should be considered before tentative conclusions are possible. Even then, the accuracy of conclusions may be doubtful unless the data were based on comparisons within given stands of virgin timber. Comparisons based on the average growth rate of insect kills and the average growth rate of living trees in a given stand are probably far more reliable than individual comparisons. The data presented here must be considered preliminary in character.

Growth rate as a selection factor on cut-over areas may not be important considering the many changes taking place during and after logging. Changes in composition, in competition, exposure to the elements, or even in soil characteristics may influence the susceptibility or resistance of sugar pines to a much greater degree than growth rate.

One point in common with all of the areas compared is that the growth rate had declined for one or more years previous to aggressive beetle activity. On the Whiskey Creek area the decline was rapid and continuous from 1927 to 1931, following which epidemic conditions prevailed. On both cut-over areas the decline in growth rate continued for 2 years. On the Shaver Lake area the decline in growth rate occurred first in 1939 and again in 1941, after several years of increased growth. Whether the sudden reduction in growth rate of a given stand has anything to do with the weakening of tree resistance to beetle attacks is a matter of conjecture at the present time. It is, at least, worthy of notation.

FIGURE I.

GROWTH RATE OF INSECT KILLED AND LIVING CHECK TREES - WHISKEY CREEK AREA - 1932

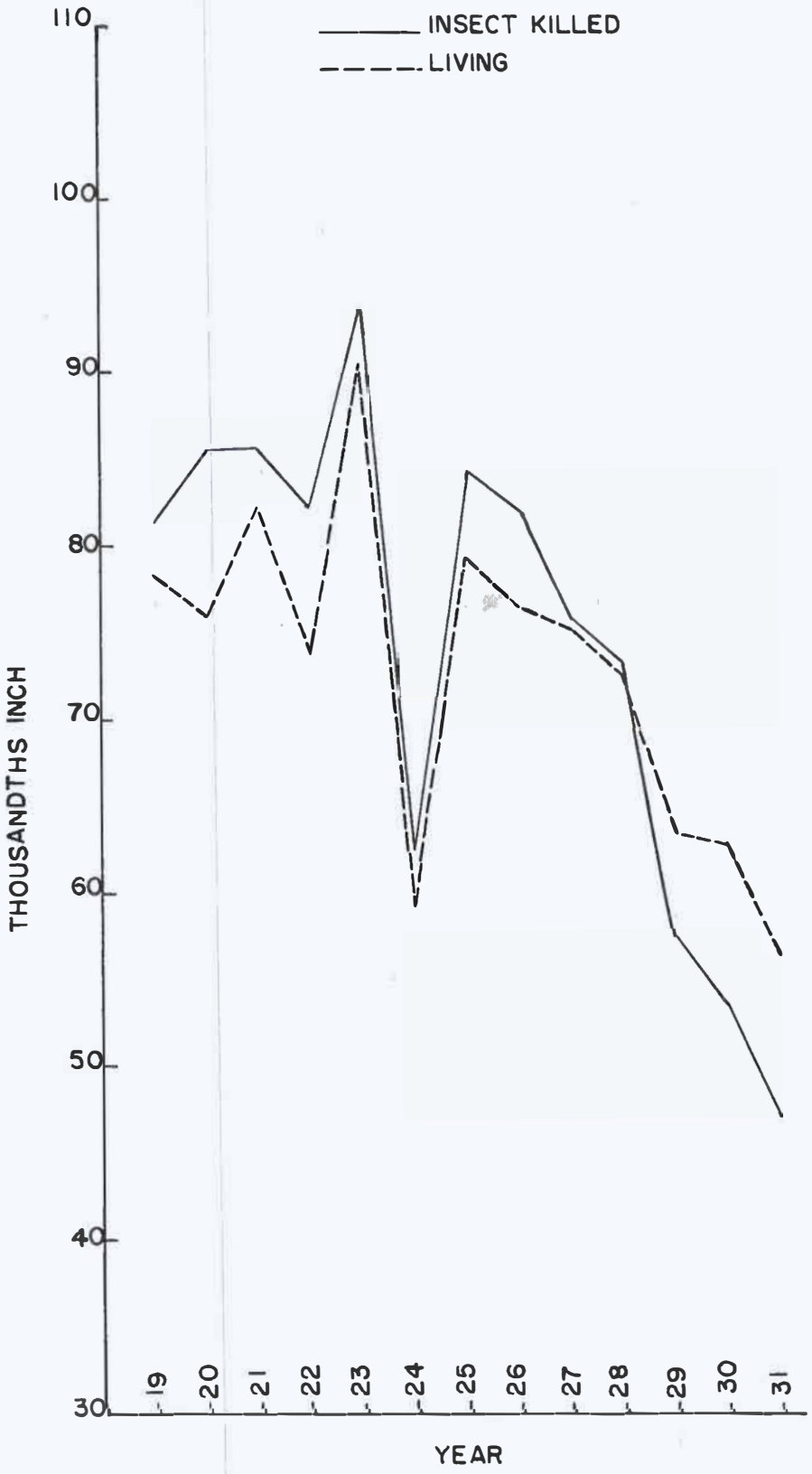
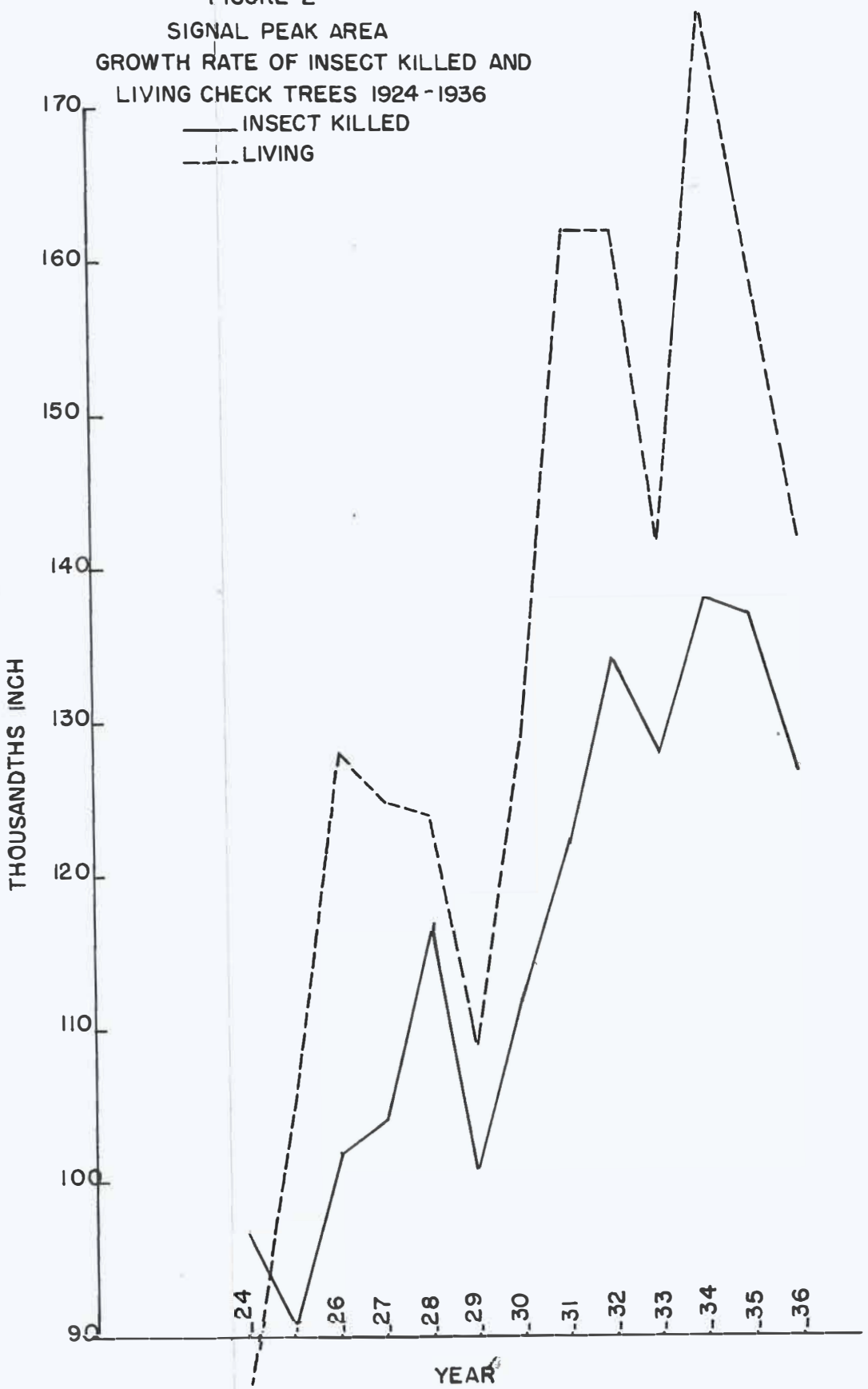


FIGURE 2

SIGNAL PEAK AREA

GROWTH RATE OF INSECT KILLED AND LIVING CHECK TREES 1924-1936



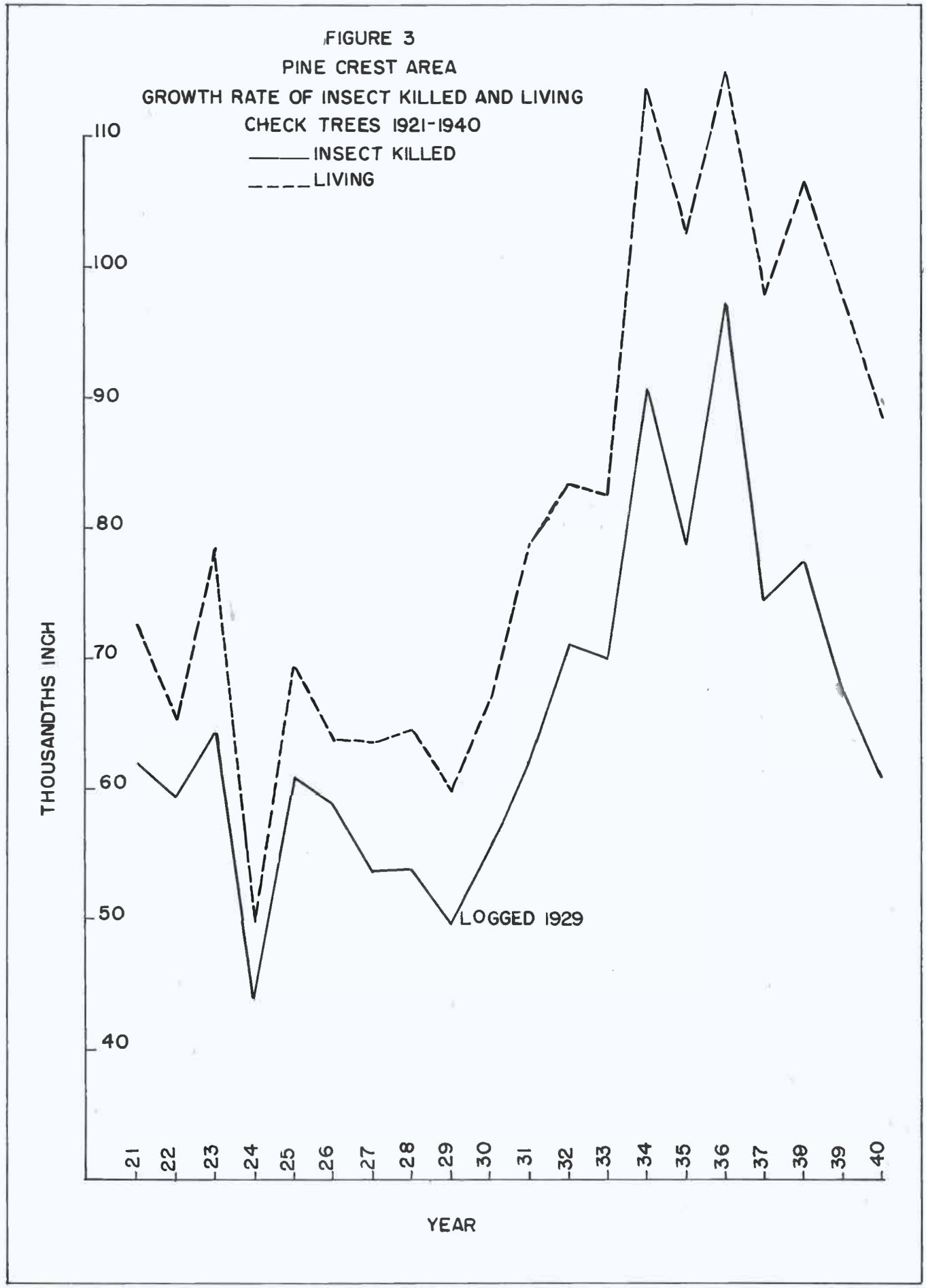


FIGURE 3
PINE CREST AREA
GROWTH RATE OF INSECT KILLED AND LIVING
CHECK TREES 1921-1940
INSECT KILLED
LIVING
110
100
90
80
70
60
50
40
THOUSANDTHS INCH
LOGGED 1929
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
YEAR

FIGURE 4

SHAVER LAKE AREA

AVERAGE GROWTH RATE OF INSECT KILLED

AND LIVING CHECK TREES 1921-1941

_____ INSECT KILLED

_ _ _ _ LIVING